frequency simultaneously transmitting earth stations in the same satellite receiving beam" for CDMA systems. For VSAT networks using Aloha, N would be 2.[160]

57. Under those proposed rules, VSAT networks using TDMA and FDMA would not be required to change their transmit power levels, while VSAT networks using CDMA would have to lower their power by some amount, based on the likely maximum number of earth stations transmitting simultaneously in the same frequency band in the same victim satellite beam.[161] The Commission noted that those proposals are substantially similar to the rules it adopted in the *18 GHz Order* for blanket licensing of Ka-band systems using FDMA, TDMA, and CDMA.[162] In addition, VSAT system operators using the Aloha technique would be required to reduce the power spectral density emitted by as much as 3 dB from the existing limits specified in Section 25.134(a).[163]

58. In the *Further Notice*, the Commission found that the rule proposed in the *Notice* was too restrictive with respect to contention protocols.[164] Accordingly, the Commission revised its proposals and invited further comment.[165] At that time, the Commission also observed that there was some support for the FDMA, TDMA, and CDMA rules proposed in the *Notice*.[166] Nevertheless, the Commission invited comment on whether the separate FDMA, TDMA, and CDMA rules would be necessary in the event that it adopted the contention protocol rule proposed in the *Further Notice*.[167]

59. In the event that the Commission decided to adopt a separate CDMA rule, the Commission also sought comment on whether replacing the phrase "likely maximum number" with "maximum number" would make the rule clearer.[168] Moreover, in the *Further Notice*, the Commission noted that it had adopted rules subsequent to the *Notice* allowing licensees to operate to conventional C-band VSAT systems, also known as CSAT systems.[169] Therefore, the Commission proposed applying the same rules to CSAT networks as it applies to Ku-band VSAT networks.[170]

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160 *See Notice*, 15 FCC Rcd at 25207-10 (App. E). In the *Third Further Notice* below, we discuss the proposal in the *Notice* for VSAT systems using a combination of reservation and contention protocols. *See* Section IV.D.5.a.

161 *Notice*, 15 FCC Rcd at 25208 (App. E).

162 *Notice*, 15 FCC Rcd at 25147 (para. 55), *citing* 47 C.F.R. § 25.138(a), *adopted in 18 GHz Order*, 15 FCC Rcd at 13492.

163 *Notice*, 15 FCC Rcd at 25147 (paras. 55-56), 25206-10 (App. E).

164 *Further Notice*, 17 FCC Rcd at 18618 (para. 85).

165 *Further Notice*, 17 FCC Rcd at 18620-21 (paras. 92-95).

166 *Further Notice*, 17 FCC Rcd at 18622 (para. 98).

167 *Further Notice*, 17 FCC Rcd at 18622 (para. 99).

168 *Further Notice*, 17 FCC Rcd at 18622 (para. 100).

169 *Further Notice*, 17 FCC Rcd at 18623 (para. 101); *citing* FWCC Request for Declaratory Ruling on Partial-Band Licensing of Earth Stations in the Fixed Satellite Service That Share Terrestrial Spectrum, *First Report and Order*, IB Docket No. 00-203, 16 FCC Rcd 11511 (2001) (*FWCC/Onsat First Report and Order*).

170 *Further Notice*, 17 FCC Rcd at 18624 (para. 104).

60. Below, in the *Third Further Notice*, we conclude that the record does not adequately support adoption of the contention protocol rules proposed in the *Further Notice*. Accordingly, we further refine our contention protocol proposals below and invite additional comment. Moreover, our decision below to reject the Commission's prior contention protocol proposal moots the issue raised in the *Further Notice* regarding whether rules for TDMA, FDMA, and CDMA would be needed if we had adopted that contention protocol proposal. For that reason, we adopt rules for VSAT systems using FDMA, TDMA, or CDMA protocols in this section of the *Sixth Report and Order*.

2. Reservation Protocols

61. *Background.* SIA supports the Commission's proposal to apply existing power level requirements for VSAT systems using TDMA and FDMA.[171] SIA also argues that, if the Commission adopts rules for contention protocols, it should also adopt rules for CDMA VSAT systems.[172] In this case, SIA supports revising the proposed CDMA rule as the Commission did in the *Further Notice*, by replacing the phrase "likely maximum number" with "maximum number" for the definition of "N" for Ku-band VSAT systems.[173] SIA further supports applying the Ku-band VSAT CDMA rules to C-band VSAT networks using CDMA.[174] No other party commented on these issues.

62. *Discussion.* SIA's recommendations are consistent with the rules proposed in the *Further Notice*. Moreover, applying those rules to CSAT networks using CDMA would make the treatment of those VSAT networks consistent with the Commission's treatment of VSAT systems in other bands using CDMA. Accordingly, we adopt the proposal in the *Further Notice* to apply the Ku-band VSAT CDMA rules to CSAT networks using CDMA.

63. Accordingly, for C-band and Ku-band VSAT systems using TDMA or FDMA, we will define "N" as 1, so that there is no change to the power limits in Section 25.134 applicable to those VSAT systems.[175] We will also define "N" for VSAT systems using CDMA in the C-band and Ku-band, as we proposed in the *Further Notice*, as the maximum number of earth stations transmitting simultaneously in the same frequency band segment in the same satellite beam.[176] We will also base the off-axis EIRP envelopes we propose below on these requirements.[177]

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171 SIA Further Comments at 20.

172 SIA Further Comments at 21.

173 SIA Further Comments at 20. *See also* SIA March 23, 2004 *Ex Parte* Statement at 3.

174 SIA Further Comments at 20.

175 As we explained above, the power limit we adopt here for reservation protocols is - 14 – 10log(N) dBW/4 kHz. When N equals 1, 10log(N) equals 0. Therefore, by setting N equal to 1 for TDMA and FDMA, we ensure that the new rule does not require VSAT network operators using TDMA or FDMA to make any adjustment.

176 *Further Notice*, 17 FCC Rcd at 18622 (para. 100). *See also Notice*, 15 FCC Rcd at 25208 (App. E).

177 We recently adopted off-axis EIRP envelopes for ESVs. *ESV Order* at para. 55. In the rule revisions we adopt today, we incorporate the provisions for FDMA, TDMA, and CDMA that we adopt here into those ESV requirements.

3. Single Channel per Carrier

64. *Background.* To the extent that TDMA, FDMA, and CDMA techniques can be applied to narrowband single channel per carrier (SCPC) transmissions, it is reasonable to apply the same requirements to SCPC transmissions as we apply to VSAT transmissions. In the *Notice* and the *Further Notice*, the Commission proposed applying the multiple access technique rules it proposed for VSAT networks to single channel per carrier (SCPC) transmissions subject to Section 25.212.[178] Section 25.212 of the Commission's rules establishes power spectral density limits for narrowband transmissions, including SCPC transmissions in the C-band.[179]

65. *Discussion.* SIA supports the Commission's proposal to apply the same requirements to SCPC earth stations and VSAT networks.[180] No one commenting on this proposal opposes it. Accordingly, we adopt this proposal. In this *Sixth Report and Order* above, we note that the Commission has adopted provisions similar to this proposal for Ka-band VSAT networks.[181] In addition, we decided to apply these requirements to Ku-band VSAT networks, CSAT networks, and ESV networks in this *Sixth Report and Order* above.[182] There is no basis in the record in this proceeding to apply different requirements to SCPC earth stations.

4. Grandfathering Multiple Access Requirements

66. *Background.* In response to the *Notice*, some commenters recommended grandfathering existing VSAT systems in the event that we adopt any new VSAT rules. The Commission did not propose any grandfathering proposals.[183] Instead, the Commission proposed transition mechanisms. The Commission did not focus on transition mechanisms for VSAT networks using TDMA and FDMA, because the rule changes proposed for those networks do not require any change in operations. For CDMA, the Commission proposed that any rules take effect 90 days after publication in the Federal Register rather than 30 days.[184] For contention protocols, the Commission invited comment on a three-part transition.[185] We discuss this proposal further in the *Third Further Notice* below.

67. *Discussion.* SIA and Spacenet oppose the Commission's proposed transition.[186] In addition, SIA recommends grandfathering of all existing VSAT systems that would otherwise be subject to new

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178 *Notice*, 15 FCC Rcd at 25187 (App. B, proposed Section 25.212(d)(2)), *Further Notice*, 17 FCC Rcd at 18624 (para. 106).

179 *See* 47 C.F.R. § 25.212(d).

180 SIA Further Comments at 20.

181 *See* Section III.B.1. above, *citing* 47 C.F.R. § 25.138(a) (Ka-band VSAT networks).

182 *See* Section III.B.2. above. *See also ESV Order* at para. 55, n.154.

183 *Further Notice*, 17 FCC Rcd at 18625 (paras. 107-08).

184 *Further Notice*, 17 FCC Rcd at 18625 (para. 107).

185 *Further Notice*, 17 FCC Rcd at 18625 (para. 108).

186 SIA Further Comments at 21; Spacenet Further Reply, Att. B at 4.

requirements.[187] SIA argues that it would be very costly to retrofit all remote terminals in all VSAT networks.[188] SIA further recommends that the cut-off date for determining whether the new rules apply to any particular earth station should be based on the date the application was filed, rather than the date the license was granted.[189]

68. We share SIA's concerns regarding the costs of retrofitting VSAT networks. We did not intend to require VSAT operators to retrofit all their remote terminals to comply with our rules. Accordingly, we will not adopt the transition mechanism proposed in the *Further Notice*. Instead, we adopt SIA's proposal in part. All VSAT systems licensed on or before the release date of this Order may be required to continue complying with the current rules. We will not base grandfathering on the date VSAT applications are filed. Instead, all VSAT systems licensed after this *Sixth Report and Order* is adopted will be required to comply with those rules at the time they take effect, 30 days after publication in the Federal Register. The concern that VSAT systems licensed in the future might be required to conduct costly retrofitting is misplaced, because the earth stations in those VSAT systems can be designed to comply with these requirements at the time they are deployed.[190]

5. Information Requirements

69. The Commission did not specifically invite comment on what information we should require applicants to provide, if any, to enable us to verify that they will comply with the TDMA, FDMA, and CDMA rules we adopt here. We note, however, that Ka-band VSAT network operators are required to comply with TDMA, FDMA, and CDMA rules substantially similar to the rules we adopt for Ku-band and C-band VSAT network operators here.[191] Ka-band VSAT network operators must provide a showing only if they exceed the power levels prescribed by the Ka-band TDMA, FDMA, and CDMA rules.[192] We adopt a similar requirement here. In cases where Ku-band and C-band VSAT network applicants plan to comply with the TDMA, FDMA, and CDMA rules, they do not need to provide any information in their applications other than that required elsewhere in Part 25. If those applicants plan to exceed those power levels, they must file their applications pursuant to the procedure for non-routine earth station applications adopted in the *Fifth Report and Order*.[193]

6. VSAT Multiple Access Conclusions

70. As noted above, the *Sixth Report and Order* in this proceeding is made up of Section III. above. In this *Sixth Report and Order*, we adopt rules to govern Ku-band and C-band VSAT systems using TDMA, FDMA, and CDMA, as proposed in the *Notice*. The new rules do not require any adjustment to the power levels of VSAT systems using TDMA or FDMA, but require a power decrease

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187 SIA Further Comments at 20-21. *See also* SIA March 23, 2004 *Ex Parte* Statement at 3.

188 SIA Further Comments at 20-21.

189 SIA Further Comments at 21.

190 Applicants are permitted to commence construction of earth stations prior to licensing, but any such construction is at the applicant's own risk. *See* 47 C.F.R. § 25.113.

191 *See* 47 C.F.R. § 25.138(a).

192 *See* 47 C.F.R. § 25.138(b).

193 *See* 47 C.F.R. § 25.220.

for VSAT systems using CDMA. The required power decrease is based on the number of simultaneously transmitting earth stations. These requirements will also apply to SCPC transmissions. VSAT networks licensed before the adoption date of this Order will not be subject to the new rules.

71. Section IV of this document below constitutes the *Third Further Notice* in this proceeding. In Section IV.D. of the *Third Further Notice* below, we refine the proposal in the *Further Notice* regarding contention protocols, and request additional comment.

IV. THIRD FURTHER NOTICE

A. Off-Axis EIRP

1. Review of Earth Station Applications Based on Off-Axis EIRP Envelope

72. *Background.* To review, the Commission currently limits routine treatment of earth station applications to those which meet *both* power level and antenna diameter requirements. We consider non-routine earth station applications on a case-by-case basis. In response to the *Notice*, a number of parties suggested an alternative: adopting a new envelope establishing off-axis EIRP spectral density limits.[194] Hughes recommends treating Ku-band VSAT systems routinely if their transmissions comply with the off-axis EIRP density envelope based on the antenna gain pattern envelope in Section 25.209 and the - 14 dBW/4 kHz input power density limit in Section 25.134, but starting at 1.8° off-axis.[195] Hughes argues that its approach combines power density and antenna gain pattern requirements into one rule. Hughes argues further that this would give earth station license applicants more flexibility because they would be able to adjust their power to compensate for their antenna gain pattern, and vice versa.[196] Hughes recommends one EIRP spectral density envelope for co-polarized beams and another for cross-polarized beams.[197]

73. Spacenet recommends adopting an off-axis EIRP density envelope for all transmissions, including those outside the GSO orbital plane.[198] Spacenet proposes starting the off-axis EIRP density envelope within the GSO orbital plane at 2° off-axis, however.[199] Furthermore, Spacenet proposes an off-axis EIRP density envelope outside of the GSO orbital plane, but instead of subtracting 14 dBW/4 kHz from the antenna gain pattern envelope in Section 25.209 as Hughes recommends, Spacenet proposes to add 3 dBW/4 kHz.[200]

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194 Hughes Comments at 11-12; PanAmSat Comments at 4; Spacenet Reply at 7-8.

195 Hughes Comments at 11-12.

196 Hughes Comments at 12.

197 Hughes Comments at 11-12.

198 Spacenet Reply at 7-8 and n.7.

199 Spacenet Reply at 7.

200 Spacenet Reply at 8 n.7. Spacenet also asserts that the power reduction proposal adopted in the *Fifth Report and Order* would be unnecessary if the Commission were to adopt an off-axis EIRP density envelope. Spacenet Reply at 9. We note that the streamlined procedures for non-routine earth stations are intended to remain in place only while we consider off-axis EIRP envelopes.

74. *Discussion.* For several reasons, we invite comment on adopting an off-axis EIRP density envelope for FSS earth stations, as Hughes and Spacenet recommend. First, we agree with Hughes that earth station license applicants should have the flexibility to reduce their power levels to compensate for a higher antenna gain pattern.[201] In fact, the Commission reached the same conclusion in the *Fifth Report and Order*,[202] in which it adopted a streamlined procedure for earth station applicants proposing to use antennas with non-routine antenna gain patterns if the applicant proposes to reduce its transmit power levels dB for dB to compensate for the amount that its antenna gain pattern exceeds the Section 25.209 standard envelope.[203] In addition, this off-axis EIRP approach might enable us to streamline our review of earth station antennas often used for broadband Internet access, even more than the streamlined earth station procedures adopted in the *Fifth Report and Order*.[204] While we expect those procedures to expedite our case-by-case review of non-routine earth station applications, case-by-base review could never be as fast as routine processing. Thus, an off-axis EIRP approach should expedite our review of all earth station applications not now considered routine, but should not increase the potential for interference to other satellite networks. Moreover, an off-axis EIRP approach for conventional C-band and Ku-band FSS earth stations would be consistent with our treatment of Ka-band FSS earth stations, and earth stations on vessels (ESVs).[205]

75. Accordingly, we seek comment on the following issue: Should the Commission review FSS earth station applications in the C-band and Ku-band solely on the basis of an off-axis EIRP envelope? In the event that we decide not to adopt off-axis EIRP envelopes for FSS earth stations, we invite parties to propose new minimum routine antenna sizes based on the revised antenna gain pattern requirements adopted in the *Sixth Report and Order* above.[206] Such proposals should be supported by adequate technical analyses. In particular, we request parties to explain the method or methods they use to replicate or estimate the antenna gain patterns generated by earth station antennas of different sizes.

76. We do not request comment on Spacenet's specific proposal for an off-axis EIRP envelope. Spacenet's recommendation would allow earth station operators to increase their EIRP spectral density by 17 dB above the levels now allowed. Spacenet provides no justification for allowing power increases that high. In addition, we noted above in the *Sixth Report and Order* that starting the antenna gain pattern envelope at an off-axis angle greater than 1.5° off-axis could unreasonably increase the risk of harmful

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201 Hughes Comments at 12.

202 *Fifth Report and Order* at para. 12.

203 *Fifth Report and Order* at paras. 41-42. Further, we agree with Spacenet that an off-axis EIRP spectral density envelope is a close substitute for the power reduction proposal adopted in the *Fifth Report and Order*. Spacenet Reply at 9. Accordingly, to facilitate implementation of the dB-for-dB power reduction procedure, we will incorporate an off-axis EIRP spectral density envelope into that procedure. In other words, earth station applicants seeking to use the streamlined power reduction procedure for non-routine earth station applications adopted in the *Fifth Report and Order* may submit a technical showing demonstrating that they meet the off-axis EIRP spectral density envelope implied by the antenna gain pattern envelope in Section 25.209 and the relevant power level rules. The "relevant" power level rules are in Section 25.134 for VSAT systems, and in Section 25.212 for other earth stations.

204 *Fifth Report and Order* at para. 12.

205 *See* 47 C.F.R § 25.138 (Ka-band earth stations); *ESV Order* at para. 55.

206 *See* Section III.A.

interference.[207] For the same reason, adopting an off-axis EIRP envelope that starts at 2° off-axis could also unreasonably increase the risk of harmful interference. Therefore, instead of Spacenet's proposed off-axis EIRP envelope, we seek comment on the off-axis EIRP envelopes discussed below.

2. Development of Off-Axis EIRP Envelope for FSS Earth Stations

a. EIRP Density Into the Antenna

77. Generally, an off-axis EIRP envelope is determined by the applicable earth station antenna gain pattern envelope and the allowed EIRP density into the antenna.[208] In Appendix C of this *Third Further Notice*, we list several proposed off-axis EIRP envelopes, designed for digital and analog transmissions from both C-band and Ku-band earth stations. Those envelopes are based on the earth station antenna gain pattern envelope rules and power requirements in Part 25 as revised in the *Sixth Report and Order* we adopt above concurrently with this *Notice*.

78. We propose adopting the off-axis EIRP envelopes in Appendix C, based on the rules adopted in the *Fifth Report and Order*, unless one or more commenters provide a convincing reason to adopt different envelopes. While we are confident that the off-axis EIRP envelopes in Appendix C provide a reasonable balance between technical requirements that are not overly restrictive for earth station applicants, yet sufficient to limit unacceptable interference, we invite parties to propose envelopes that may provide a better balance. We developed an extensive record on the antenna gain pattern envelope rule revisions we adopt in the *Sixth Report and Order* above,[209] and with one exception, discussed below, we do not intend to reopen those issues in this *Third Further Notice*. Accordingly, we will start the off-axis EIRP envelope at 1.5° off-axis within the GSO orbital plane, for both C-band and Ku-band earth stations. We will start the Ku-band off-axis EIRP envelope at 3° off-axis outside the GSO orbital plane. Below, we invite comment on starting the C-band off-axis EIRP envelope at 3° off-axis outside the GSO orbital plane.

79. Parties proposing alternative EIRP envelopes should support their proposals with a technical study showing that any proposed increase in EIRP will not result in unacceptable interference to other adjacent satellite or terrestrial operations. One possible format for such a study is the Adjacent Satellite Interference Analysis (ASIA).[210] We also request that parties conducting such studies provide their data and discuss their calculations in sufficient detail that the Commission and interested parties can review their studies. The Commission will place much more weight on a study whose methods and data are fully discussed in the record than a study in which the results are presented only in summary fashion.

80. In summary, we invite commenters to provide detailed technical studies that are adequate to support adoption of off-axis EIRP envelopes other than those listed in Appendix C to this *Third Further Notice*. In the event that no such studies are submitted, or that the studies that are submitted are not discussed in sufficient detail, we proposed adopting the antenna gain pattern envelopes in Appendix C.

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207 *See* Section III.A.2.

208 *See ESV Order* at paras. 55, 99.

209 *See* Section III.A. above.

210 The Commission used ASIA to develop the downlink EIRP density requirements adopted in the *Fifth Report and Order*. *See Fifth Report and Order* at App. C.

b. Elliptical C-band Earth Stations

81. In the *Sixth Report and Order* in this proceeding, we adopt rule revisions to begin the Ku-band antenna gain pattern envelope outside the GSO orbital plane at 3.0° off-axis.[211] This will allow us to license more Ku-band elliptical earth station antennas on a routine basis than was possible in the past.[212] The Commission limited its proposed rule revisions to Ku-band antennas to be consistent with new ITU requirements, and because the Ku-band is not shared with terrestrial wireless operations.[213]

82. Here, we propose starting the C-band antenna gain pattern envelope outside the GSO orbital plane, and the comparable C-band off-axis EIRP envelope, at 3.0° off-axis, rather than 1.5° off-axis.[214] Adopting this proposal would enable the Commission to adopt routine processing standards for elliptical C-band earth station antennas. This, in turn, could reduce the costs of installing and operating C-band earth stations, particularly in the case of temporary-fixed earth stations. Also, we invite comment on whether the existing coordination procedure in Section 25.203(c) of the Commission's rules is adequate for coordinating elliptical C-band earth stations with terrestrial wireless operations. Finally, we invite comment on whether we should increase the minimum angle of elevation for elliptical C-band earth stations above the 5° minimum currently in the rules,[215] to further reduce the possibility of harmful interference to terrestrial wireless operations, in the event that the Commission adopts the rule proposed here.

83. The C-band off-axis EIRP envelopes in Appendix C assume that we will adopt the proposal to start the envelope outside the GSO orbital plane at 3° off-axis. In the event that the record in this proceeding persuades us to reject this proposal, we tentatively conclude that we should retain the current rule and start the C-band off-axis EIRP envelope outside the GSO orbital plane at 1.5° off-axis.

c. Analog Video Services

84. Historically, Part 25 has not provided EIRP density limits for analog video transmissions, in either the C-band or the Ku-band. The revisions to Part 25 adopted in the *Fifth Report and Order* do not change this. Instead, Section 25.211(d) of the Commission's rules provides EIRP limits rather than EIRP density limits for analog video transmissions.[216] Accordingly, we invite comment on several possible approaches for addressing analog video transmissions under off-axis EIRP requirements.

85. One option is to apply the off-axis EIRP limits proposed in Appendix C for other narrowband analog transmissions to analog video transmissions. A potential concern with this option is that analog video transmissions are generally the most likely to cause interference into other licensed operations.[217] It

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211 Section III.A.4. above.

212 Section III.A.4. above.

213 *Further Notice*, 17 FCC Rcd at 18610-11 (para. 65).

214 Section III.A. above.

215 47 C.F.R. § 25.205.

216 The analog video EIRP limits are 26.5 dBW in the C-band, and 27 dBW in the Ku-band. 47 C.F.R. § 25.211(d).

217 *See Further Notice*, 17 FCC Rcd at 18635 (para. 136), *citing Ku-band Antenna Gain Pattern Revision Order*, 8 FCC Rcd at 1320 (para. 24). *See also* Section III.A. above.

is not clear whether the analog off-axis EIRP envelopes proposed in Appendix C are sufficient to protect other licensed transmissions. Therefore, we request commenters supporting this approach to provide an appropriate technical study. Such studies should be sufficiently detailed to enable the Commission and other interested parties to review the calculations and to comment on the results. We noted above that a complete ASIA study can fit this description, but we will consider studies in other formats.

86. Another option is to develop new off-axis EIRP envelopes applicable to C-band and Ku-band analog video transmissions. Such requirements should be sufficient to prevent analog video transmissions from causing harmful interference to other licensed operations, but still allow analog video licensees to complete their links with the satellites with which they are communicating. Again, parties supporting this approach should provide a sufficiently detailed technical study to support their recommendation.

87. Finally, the Commission could prohibit analog video transmissions, the alternative we propose here. The Commission has observed in the past that analog video transmissions are more susceptible to harmful interference from other transmissions and more likely to cause harmful interference to other transmissions.[218] Thus, a prohibition on analog video transmissions may result in more efficient spectrum use. We also note that analog satellite transmissions are declining.[219] Thus, technical rules for analog video may no longer be necessary.

88. Accordingly, we propose prohibiting analog video transmissions, unless one or more commenters makes a convincing case that analog video transmissions are necessary, and a detailed technical study that provides a sufficient basis for an analog video off-axis EIRP envelope. We also propose a transition period of no more than one year. Commenters supporting continued use of analog video transmissions should specify the extent to which they currently use analog technology to transmit video, and the extent to which they plan to continue doing so. They should also indicate whether and to what extent converting from analog to digital transmissions will cause them any particular hardship, in terms of equipment costs or for any other reason, and how those costs compare to any benefits that might result from such a transition. Some of those benefits may accrue only to the licensee, in the form of higher quality or faster transmissions. Other benefits may accrue to society as a whole, in terms of more efficient spectrum use. Parties supporting prohibition of analog video services should explain whether a transition period for analog video is necessary or desirable, and if so, how long.

d. Other Services

89. As we noted above, the Commission has already adopted an off-axis EIRP envelope for FSS earth stations in the Ka-band.[220] In addition, the Commission has adopted off-axis EIRP requirements for

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[218] *Further Notice*, 17 FCC Rcd at 18635 (para. 136); *Ku-band Antenna Gain Pattern Revision Order*, 8 FCC Rcd at 1320 (para. 24); *Fifth Report and Order* at para. 106.

[219] In the *Fifth Report and Order*, the Commission found that there were no licensed analog emissions in the Ku-band as of October 1, 2004. *Fifth Report and Order* at para. 94. However, in 2001 the Commission staff reviewed the licenses in the earth station database, and found that only 183 of 4884 licensed emissions in the 14.0-14.5 GHz band (approximately 3.7 percent) and 52 of 2134 licensed emissions in the 11.7-12.2 GHz band (approximately 2.4 percent) were for analog audio operations.

[220] 47 C.F.R. § 25.138.

Ku-band FSS earth stations communicating with NGSO satellites.[221] We do not propose any revisions to those requirements at this time.[222]

90. We also find that we do not need to propose any off-axis EIRP requirements for mobile satellite service (MSS) earth stations. Those earth stations generally have little or no directivity towards a satellite, so that the earth station must track the satellite in all directions, such as hand-held satellite telephones. As a result, satellite systems communicating with MSS earth stations generally cannot operate on the same spectrum without causing unacceptable interference to each other.[223] Because the Commission usually does not license more than one MSS system to communicate in any given frequency band,[224] there is no need to limit the off-axis EIRP transmissions of MSS earth stations.

3. Protection from Interference

91. The off-axis EIRP rules proposed above are designed to ensure that earth stations do not cause harmful interference into adjacent satellite space stations with their Earth-to-space transmissions. In this section, we invite comment on developing rules to protect earth station licensees from receiving harmful interference from space-to-Earth transmissions. We request comment on whether earth stations should be protected from harmful radio interference and if so, by what procedures.[225] As a starting point for discussion, we note that under current rules, earth station antennas licensed in the fixed satellite service are protected from harmful interference caused by other space stations (not their communications target) so long as the antenna conforms to the antenna gain reference patterns specified in our rules.[226] Limiting off-axis EIRP, by itself, does not protect the earth station from receiving interference. Accordingly, if we replace the current antenna gain reference pattern requirements in Section 25.209 with an off-axis EIRP envelope for earth stations in the fixed satellite service, we invite comment on whether to adopt a standard comparable to Section 25.209(c) to protect earth stations from harmful interference? Should our decision to revise the antenna gain reference pattern to start at 1.5° from the main lobe affect an earth station operator's ability to claim protection from harmful interference?

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221 *See* 47 C.F.R. § 25.146(a)(2).

222 As we noted above, the Commission has also adopted off-axis EIRP envelopes for ESVs. We conclude that no revisions to the ESV off-axis EIRP envelopes are warranted, other than the incorporation of rules to reflect TDMA, FDMA, and CDMA multiple access techniques, as discussed above.

223 *See* Amendment of the Commission's Space Station Licensing Rules and Policies, *First Report and Order*, IB Docket No. 02-34, 18 FCC Rcd 10760, 10773 (para. 21) (2003) (*Space Station Reform First Report and Order*).

224 There are some exceptions to this general rule. For example, the Commission has issued MSS licenses in the Little LEO bands and the Big LEO bands that require sharing with other MSS operators in certain bands. Nevertheless, we do not propose imposing off-axis EIRP requirements on these licensees at this time. This is because the sharing requirements and other technical rules in both the Little LEO and Big LEO bands are based on a careful balancing of competing interests, and imposing new off-axis EIRP requirements at this time might adversely affect those balances.

225 We also note that, in the *Interference Temperature Inquiry*, the Commission is exploring spectrum management based on cumulative effects of all undesired radio frequency energy. Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands, *Notice of Inquiry and Notice of Proposed Rulemaking*, ET Docket No. 03-237, 18 FCC Rcd 25309 (2003) (*Interference Temperature Inquiry*).

226 47 C.F.R. § 25.209(c).

92. We also seek general comment on procedures employed to resolve complaints of harmful interference. The general approach of the Commission's rules in these situations has been to require earth station operators to make every effort to identify the source of harmful interference and to coordinate in good faith with the source in order to resolve the interference. In dealing with instances of harmful interference, our current rules allow satellite system control center operators to contact the Commission's Columbia, Maryland Operations Center for assistance in resolving problems.[227] These procedures have generally been effective in minimizing Commission involvement in problems while at the same time allowing neutral expert advice from the Commission. We propose continuing to apply these procedures if and when earth station antennas are licensed based on an off-axis EIRP envelope. We invite any proposals that address the potential for inter-system harmful interference, and any proposed procedures for resolving instances of harmful interference.

B. Procedure for Earth Station Applications that Exceed the Off-Axis EIRP Envelope

93. Much of the Commission's Part 25 satellite rules is premised on the expectation that adjacent satellite system operators will maintain a cooperative working relationship with each other, which should allow them to accommodate a given earth station's non-conforming operations if those operations do not result in unacceptable interference. Based on that expectation, in the *Fifth Report and Order*, the Commission codified a procedure for applicants proposing smaller-than-routine earth stations by requiring those applicants to certify that their target satellite operator has coordinated the non-conforming operations with adjacent satellite operators. Likewise, applicants proposing earth stations with higher-than-routine power levels must certify that their target satellite has coordinated with adjacent satellites. In either case, the certified coordination would have taken place prior to the filing of the earth station application. In addition, as a backstop mechanism, the Commission adopted a post-filing coordination procedure consisting of 30 days of comment after public notice of the earth station application, together with an ensuing 60-day period to resolve any coordination issues raised in public comment.[228]

94. If, based on the record filed in response to this *Third Further Notice*, the Commission decides to adopt an off-axis EIRP envelope, we request parties to discuss whether any additional procedures are necessary to ensure that earth stations exceeding the applicable off-axis EIRP envelope have been fully coordinated, or whether any such earth station application should be immediately denied because it is likely to cause harmful interference to adjacent satellites or to terrestrial wireless operations. In the *Sixth Report and Order* above, we relaxed the starting point for the antenna gain pattern envelope. Also, in this *Third Further Notice*, we invite comment on relaxing the transmitting EIRP levels. As a result of these rules, it may not be possible to exceed the off-axis EIRP envelope without causing harmful interference to adjacent satellites. We invite comment on limiting these procedures to frequency bands that are not shared with terrestrial wireless operations, and requiring earth stations operating in shared bands to comply with any off-axis EIRP envelopes that we adopt in this proceeding.

95. In the event that we adopt a procedure for applications for earth station that exceed the applicable off-axis EIRP envelope, we seek comment on what procedural coordination requirements the Commission should employ to evaluate non-routine earth station applications. We seek comment on whether the procedures adopted in the *Fifth Report and Order* -- consisting of certification of pre-filing coordination and post-filing coordination based on public comment and additional inter-operator discussion -- are appropriate for use in evaluating applications that exceed specified off-axis EIRP

227 47 C.F.R. § 25.274.

228 *Fifth Report and Order* at paras. 70-79.

envelopes. We also request comment on any additional or alternative procedures that might be used in evaluating earth station applications that exceed the applicable off-axis EIRP envelope.

96. In addition, we seek comment on whether to employ case-by-case evaluation of adjacent satellite coordination for other purposes. Much of the streamlining and efficiency expected from the rules adopted in the *Fifth Report and Order*, as well as the further flexibility we propose in this further notice of proposed rulemaking, relies on advance coordination among satellite operators before an earth station application is filed. We request comment on whether our expectation of good-faith coordination among satellite system operators is well-founded and is self-policing. If not, should the Commission consider any additional regulation designed to enforce good-faith coordination? For example, if an earth station operator repeatedly filed applications without the required advance certification from affected adjacent satellite operators, or repeatedly omitted affected operators, should that operator be penalized in some fashion? One possibility would be to declare the offending earth station operator ineligible for streamlined evaluation of its applications, requiring that each and every future application be evaluated on a case-by-case basis. If such a penalty were to be employed to enforce the coordination rules, how many faults, and what type of fault, would trigger the penalty? How long should the penalty be enforced before the Commission could again reasonably rely on the earth station operator's certifications in support of streamlined grant? We invite comment on whether this or any other type of enforcement may be necessary to ensure reliable operation of earth station evaluation based on off-axis EIRP envelopes.

C. Information Requirements

97. In the event that the Commission adopts an off-axis EIRP approach for earth stations, we invite comment on revising the Commission's information requirements associated with earth station applications. We see two general options. Under one option, the Commission could require earth station applicants to submit a graph showing that their proposed earth station will meet the applicable off-axis EIRP envelope. Under the other option, earth station applicants would be required to provide a table showing the EIRP of the antenna at various specific off-axis angles.

98. We propose requiring a table. It would be easier to develop a computer program to automate the review of tabular information than it would to develop a program for reviewing graphs. Developing such a computer program is necessary to enable the Commission to act on earth station applications under off-axis EIRP requirements as quickly as it acts on routine earth station applications under the current rules. We believe that the public interest would suffer if adopting off-axis EIRP requirements were to result in a slower earth station procedure.

99. We also propose delegating authority to the International Bureau (Bureau) to develop and implement new electronic application forms and revisions to the International Bureau Filing System (IBFS) necessitated by an off-axis EIRP requirement for earth stations. This delegation includes determining when the revised IBFS program should be initiated, establishing any procedures needed to assure security, and addressing any other issues that may arise regarding the electronic filing of earth station applications under an off-axis EIRP approach. In addition, we propose directing the Bureau to consult with industry and potential users informally and share plans for its proposed implementation, and to make any necessary adjustments in light of industry and user views, as appropriate. Finally, we propose directing the Bureau to implement this program in coordination with other electronic filing initiatives within the agency, as appropriate. We note that the delegation of authority we propose here is comparable to delegations the Commission has adopted in the past to implement electronic filing requirements.[229]

[229] Implementation of Section 402(b)(1)(A) of the Telecommunications Act of 1996, *Report and Order*, CC Docket No. 96-187, 12 FCC Rcd 2170, 2195 (para. 48) (1997).

D. Contention Protocol Proposals

1. Background

100. Earlier, we revised our rules for VSAT networks and SCPC earth stations using TDMA, FDMA, and CDMA protocols.[230] Now, we discuss VSAT networks using contention protocols, reaching decisions on some issues and refining our contention protocol proposals further on other issues.

2. Need for Rule Revisions

101. *Background.* SIA and Spacenet argue that the Commission does not need to regulate VSAT contention protocols because there have not been any reported cases of interference caused by use of contention protocols, and because licensees can work together to resolve any interference.[231] According to Aloha Networks, there have been no interference complaints because use of contention protocols is fairly limited. Aloha Networks also claims that VSAT usage for Internet access is not yet widespread, but expects VSAT-based Internet access to grow in the near future, and expects contention protocol usage to grow as VSAT-based Internet access grows.[232] Aloha Networks also points out, however, that technology now exists that can address potential interference that cannot be controlled through mutual cooperation, such as the Spread Aloha Multiple Access technique, contention-based CDMA, or fast frequency hopping.[233] SIA replies that consumer Internet-access VSAT networks have been in operation since 2000, and now have hundreds of thousands of customers, and this large growth has not resulted in interference claims.[234] Aloha Networks alleges that opposition to regulating contention protocols is based on reliance on older equipment and resistance to newer technologies.[235] Spacenet contends that Aloha Networks is seeking rules that would give it a competitive advantage in marketing its technology.[236]

102. Spacenet also contends that satellite operators and VSAT network operators have incentives to limit collisions, and this will result in limiting harmful adjacent satellite interference.[237] Aloha Networks doubts whether these economic incentives to maintain network quality will limit harmful interference.[238]

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230 Section III.B. above.

231 SIA Further Comments at 18; SIA Further Reply at 5; Spacenet Further Comments at 15 and Att. B; Spacenet Further Reply at 2-3. *See also* SIA March 23, 2004 *Ex Parte* Statement at 3.

232 Aloha Networks Further Reply at 1-4.

233 Aloha Networks Further Reply at 2.

234 SIA Further Reply at 5.

235 Aloha Networks Further Reply at 6.

236 Spacenet Further Reply at 5 and Att. B at 2-3.

237 Spacenet Further Comments at 15.

238 Aloha Networks Further Reply at 3.

103. *Discussion.* Section 25.134 of the Commission's rules establishes limits for individual earth station antenna input power densities as received by the satellite receiver.[239] Use of contention protocols results in aggregate antenna input power densities that exceed these limits.[240] The Commission observed in the *Further Notice* that use of contention protocols can increase the efficiency of VSAT networks.[241] Therefore, we want to revise Section 25.134 to allow VSAT network operators to take advantage of those efficiencies.

104. We also find unpersuasive SIA's and Spacenet's assertions that we do not need any regulations for contention protocols. While there have been no allegations of harmful interference to date, that by itself does not warrant allowing VSAT operators to operate their networks with an unlimited number of collisions of unlimited duration and unlimited input power levels. Any VSAT operator using a contention protocol is doing so pursuant to the Bureau's December 2000 waiver, and that waiver was limited to VSAT operators using multiple access techniques at the time the waiver was granted.[242] Thus, any growth in satellite Internet service that employs a contention protocol would exceed the terms of the waiver. Consequently, we have not seen, as SIA asserts, a large growth in the use of contention protocols since 2000. Further, Spacenet has not adequately supported its argument that the incentive to limit interference within a VSAT network will be adequate to prevent harmful interference to adjacent satellite systems.[243]

3. Outstanding Proposals

a. The *Further Notice* Proposal

105. In the *Further Notice*, the Commission invited comment on a rule that would provide for routine processing for Ku-band VSAT systems using multiple access techniques under the following conditions:

> (i) Each earth station individually satisfies the power density limits of Section 25.134(a);
> (ii) The maximum transmitter power spectral density of a digital modulated carrier into any GSO FSS earth station antenna shall not exceed - 14.0 - 10 log(N) dB(W/4 kHz), where N is the smallest number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam such that the probability of an event with greater than N simultaneous transmitters is less than 0.01; and

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239 47 C.F.R. § 25.134(a), (b). *See also* Spacenet Further Comments at 14-15.

240 *Spacenet Order*, 15 FCC Rcd at 23715 (para. 9).

241 *Further Notice*, 17 FCC Rcd at 18618 (para. 85).

242 *See Spacenet Order*, 15 FCC Rcd at 23716 (para. 12). The Commission stated that this waiver will remain in effect until any multiple access technique rules adopted in this proceeding take effect. *Further Notice*, 17 FCC Rcd at 18626 n.219.

243 In the *Further Notice*, the Commission explained that there was nothing in the record at that time to warrant a conclusion that the amount of traffic in a VSAT network that would result in uneconomic levels of internal interference would be less than the traffic levels that would cause harmful interference to adjacent satellites. *Further Notice*, 17 FCC Rcd at 18619 (para. 87). Spacenet repeats this argument in their further pleadings, but does not provide any further support.

(iii) The maximum duration of any single collision is less than 100 milliseconds.[244]

This proposed rule was based on a recommendation by Aloha Networks. Aloha Networks based Clauses (i) and (iii) of its proposed rule on Spacenet's proposal in its petition for declaratory ruling.[245] Aloha Networks also explained that its clause (ii) is not system-specific, as Spacenet's was. Rather, it uses a quantifiable standard that could be applied to systems developed in the future.[246]

106. The Commission stated that this proposal would ensure that VSAT network operators would decrease their power spectral density when the number of transmissions on the same frequency within the VSAT network is likely to exceed a certain level, and is applicable to any random access technique using a contention protocol.[247] Aloha Networks proposed a probability of 0.001, but the Commission increased this to 0.01 based on Hughes's observation that the Commission found that a 0.01 probability would not be excessive in the *Notice*.[248] The Commission expected that this would provide a reasonable balance between protecting against interference in the future as satellite traffic increases, and limiting burdens on VSAT licensees.[249] None of the commenters support this proposal, and several propose alternatives. Below, we summarize the parties' criticisms of the *Further Notice* proposal, and each of their alternatives.

b. Aloha Networks

107. Aloha Networks asserts that the Commission's proposal does not provide adequate protection against adjacent satellite interference during collisions.[250] Aloha Networks recommends reducing the maximum allowable probability of collision from 1 percent to 0.1 percent, or decreasing the maximum duration of collision from 100 milliseconds to 10 milliseconds.[251] SIA asserts that Aloha Networks has not provided an adequate basis for a rule more restrictive than the rule proposed in the *Further Notice*.[252]

c. SIA and Spacenet

108. In their further comments, both SIA and Spacenet oppose the Commission's proposal, and recommended revisions in the event that the Commission finds it necessary to adopt any rules. In

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244 *Further Notice*, 17 FCC Rcd at 18619-21 (paras. 90-94).

245 *Further Notice*, 17 FCC Rcd at 18620 (para. 91), *citing Spacenet Order*, 15 FCC Rcd at 23714-15 (para. 7).

246 *Further Notice*, 17 FCC Rcd at 18620 (para. 91).

247 *Further Notice*, 17 FCC Rcd at 18620 (para. 92).

248 *See Further Notice*, 17 FCC Rcd at 18620 (para. 93); *Notice*, 15 FCC Rcd at 25209 (App. E).

249 *Further Notice*, 17 FCC Rcd at 18620-21 (para. 94).

250 Aloha Networks Further Comments at 4-6; Aloha Networks Further Reply at 4-5.

251 Aloha Networks Further Comments at 3-4; Aloha Networks Further Reply at 5.

252 SIA Further Reply at 6-7. *See also* SIA October 3, 2003 *Ex Parte* Statement at 7.

Spacenet's reply, it combines elements of its original proposal with SIA's proposal, to form a new proposal.

109. In its further comments, Spacenet asserts that the Commission's proposal contains an inflexible power limit which might unreasonably restrict the growth of VSAT services.[253] Instead, Spacenet argues that VSAT operators should be allowed to exceed the -14 dBW/4kHz limit by small but increasing amounts as the probability of collisions decreases.[254] Specifically, Spacenet's initial proposal is as follows:

> (i) Each earth station individually satisfies the power density limits of Section 25.134(a);
> (ii) The maximum transmitter power spectral density of a digital modulated carrier into any GSO FSS earth station antenna shall not exceed the lesser of - 14.0 dB(W/4 kHz) or - 14 + 2K - 10log{N(K)} dB(W/4kHz), where N(K) is the smallest number of simultaneously transmitting co-channel earth stations in the same satellite receiving beam such that the probability of an event with greater than N(K) simultaneous transmissions is less than 10^{-K} for integer values of K greater or equal to one; and
> (iii) The maximum duration of any single collision is less than 100 milliseconds.[255]

Clauses (i) and (iii) are the same as the ones in the *Further Notice* proposal. Spacenet originally proposed to add the "2K" and the "10log{N(K)}" terms to Clause (ii), where K is an integer greater than or equal to one, and N(K) is an integer defined as the smallest number of simultaneously transmitting co-channel earth stations in the same satellite receiving beam such that the probability of an event with greater than N(K) simultaneous transmissions is less than 10^{-K}. Thus, as the probability of a collision involving any given number of transmissions decreases, the power increase permitted during that collision increases.[256]

110. SIA maintains that the Commission's proposed rule places VSAT operators with relatively short bursts of data at a disadvantage, even though such VSAT networks are less likely to cause harmful interference than a network with longer bursts.[257] In particular, SIA explains that the Commission's proposal limits the probability of collision in a VSAT network with 100-millisecond transmissions to one percent.[258] SIA explains further that VSAT networks with transmissions shorter-than-100 milliseconds should not be regulated as strictly as VSAT networks with 100-millisecond transmissions, because shorter transmissions result in shorter collisions, and so are less likely to cause harmful interference.[259] Accordingly, SIA recommends replacing Clause (ii) of the Commission's proposal with the following:

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253 Spacenet Further Comments at 16.

254 Spacenet Further Comments at 19-20.

255 *See* Spacenet Further Comments at 17.

256 Spacenet Further Comments at 17, 19-20, Spacenet Further Reply at Att. A.

257 SIA Further Comments at 19; SIA Further Reply at 6-7.

258 SIA Further Comments at 19.

259 SIA Further Comments at 19.

> "The maximum transmitter power spectral density of a digital modulated carrier into any GSO FSS earth station shall not exceed -14 - 10log(N) dB(W/4 kHz), where N is an integer. The number N is defined such that, during any 100 milliseconds interval, the probability that Q>N*100 is less than 0.01, where Q = the accumulated transmission time of all co-frequency simultaneously transmitting earth stations in the same satellite receiving beam. The maximum duration of any single collision is less than 100 milliseconds."[260]

SIA observes that, by adding "Q", the accumulated transmission time of all co-frequency simultaneously transmitting earth stations in the same satellite receiving beam, the rule still limits the probability of a collision in any 100-millisecond interval to one percent, without disadvantaging VSAT networks with shorter transmissions relative to those with longer transmissions.[261]

111. In its Further Reply, SIA observes that Spacenet's alternative gives VSAT operators greater flexibility than the Commission's proposed rule, but asserts that Spacenet's alternative would still place VSAT systems with shorter transmission times at a disadvantage.[262] In Spacenet's Further Reply, it concurs with SIA regarding transmission times, and incorporates SIA's proposed rule into a revised proposal as follows:

> (i) Each earth station individually satisfies the power density limits of Section 25.134(a).
> (ii) The maximum transmitter power spectral density of a digital modulated carrier into any GSO FSS earth station antenna shall not exceed the lesser of -14 dB(W/4kHz) or - 14 + 2K - 10log{N(K)} dB(W/4kHz), where N(K) is an integer. N(K) is defined such that, during any 100 millisecond interval, the probability that Q>N(K) x 100 milliseconds is less than 10^{-K}, where Q = the accumulated transmission time of all co-frequency simultaneously transmitting earth stations in the same satellite receiving beam.
> (iii) The maximum duration of any single collision is less than 100 milliseconds.[263]

112. Aloha Networks contends that allowing a one percent probability of collisions lasting for 100 milliseconds is not acceptable for a VSAT network transmitting packets that are six milliseconds or 80 microseconds.[264] Aloha Networks also argues that there is no reason to allow higher power levels for shorter periods of time, as Spacenet recommends, and asserts that this proposal undercuts Spacenet's contention that economic factors can adequately limit harmful interference.[265] Telesat supports Spacenet's proposal.[266]

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260 SIA Further Comments at 18-19; SIA Further Reply at 6; SIA October 3, 2003 *Ex Parte* Statement at 6-7.

261 SIA Further Comments at 19.

262 SIA Further Reply at 8-9.

263 Spacenet Further Reply at 4-5.

264 Aloha Networks Further Reply at 6.

265 Aloha Networks Further Reply at 5-6.

d. Discussion

113. All the contention protocol rule proposals in the record have four elements: (i) a power density limit on individual earth stations in the VSAT network; (ii) a limit on the power generated during collisions, (iii) a limit on the probability of collisions, and (iv) a limit on the duration of any collision. Generally, the proposed rules state the allowed power during collisions as a function of the probability of collision. As an initial matter, we note that the record provides an adequate basis to resolve several of these issues. We also find, however, that we need to develop the record further on other issues. We also find that none of the proposals in the record would be consistent with the off-axis EIRP envelope approach proposed in this *Third Further Notice* above. We discuss these issues further below.

114. First, we note that the Commission in the *Further Notice* proposed requiring that each earth station in a VSAT network using a contention protocol individually satisfy the power density limits of Section 25.134(a).[267] All the commenters include identical or substantially similar requirements in their proposals. Accordingly, we conclude that any contention protocol rule we adopt should include a similar requirement. However, we also observe that we will no longer have VSAT power density limits if we adopt the off-axis EIRP envelope proposals discussed above. Accordingly, in the event that we adopt off-axis EIRP envelopes, we propose applying an aggregate off-axis EIRP envelope to VSAT networks. Implicit in the concept of an off-axis EIRP envelope is an assumption that the technical parameters of an earth station examined in a vacuum is not as relevant as determining whether those parameters considered together would cause harmful interference to an adjacent satellite. Similarly, it may be reasonable to conclude that the power levels of individual earth stations in a VSAT network are not as relevant as determining whether the VSAT network in the aggregate would cause harmful interference to an adjacent satellite. We invite comment on this analysis, and discuss this further below.

115. We also conclude that the record does not provide a basis for determining whether or to what extent to limit the power levels resulting from collisions. On one hand, we are sympathetic to Spacenet's concern that an inflexible power limit of the kind proposed in the *Further Notice* might unreasonably restrict the growth of VSAT services.[268] We also agree with SIA that there is no need to treat collisions of 100 milliseconds the same as collisions of shorter duration, and so conclude that some sort of averaging of the kind that SIA proposes with its "Q" term is warranted. Similarly, one of the commenters in the *Spacenet Order* proposes an averaging approach: "The total average power radiated toward the target satellite by all the remote earth stations in the network, using an averaging period of one second, is less than that of a single remote earth station transmitting continuously."[269] On the other hand, the SIA/Spacenet proposal would allow VSAT operators to exceed, in the aggregate, the -14 dBW/4 kHz power limit by 2 dB 10 percent of the time, whenever the probability of two or more simultaneous transmissions is greater than 10 percent. In the absence of any evidence to the contrary, we conclude that such a high power level increase for such a large amount of time would cause unacceptable interference to adjacent satellite operators.

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266 Telesat Further Reply at 5.

267 *Further Notice*, 17 FCC Rcd at 18619-20 (para. 90).

268 Spacenet Further Comments at 16.

269 *See Spacenet Order*, 15 FCC Rcd at 23715 (para. 8).

116. Regarding limits on the probability of collision, we reject the Aloha Networks proposal to limit the probability to 0.1 percent. We agree with SIA and Spacenet, however, that Aloha Networks does not provide a persuasive reason to adopt its proposal. Aloha Networks claims that VSAT networks can transmit messages as short as six milliseconds, and a rule that allows a 100-to-1 chance that a transmission in a VSAT network will experience a collision for 0.1 seconds will result in too much harmful interference in cases where the victim of the interference is a six-millisecond transmission.[270] Although a victim transmission on a particular satellite network may need to be retransmitted, if forward error correction cannot correct any reception errors resulting from a collision in transmissions on an adjacent satellite network, Aloha Networks has not shown that the number of collisions that would be allowed by a 1 percent probability of collision would result in a noticeable increase in the number of data transmission errors, retransmission rate, or latency in adjacent satellite networks.

117. Moreover, we take this opportunity to question whether a hard limit on the probability of collision is necessary. We note that neither SIA nor Spacenet proposed such a limit. Instead, they proposed flexible power limits that increase as the probability of collision decreases, and *vice versa*. Our concern with SIA's and Spacenet's proposals is that, under certain circumstances, it would allow VSAT operators to exceed the applicable power limit by 2 dB as much as 10 percent of the time, not that the probability of collision must be limited regardless of the increase in power resulting from the collision. Furthermore, we observe that the use of the Aloha multiple access technique as described in the *Spacenet Order* results in a probability of collision greater than 1 percent.[271] We will incorporate these considerations into the new contention protocol requirements we propose below.

118. Finally, we find that there is sufficient support in the record for the requirement proposed in the *Further Notice* to limit the maximum duration of any collision to 100 milliseconds. Both SIA and Spacenet include a 100-millisecond limit in their proposals. Aloha Networks is the only commenters suggesting a more restrictive limit. Aloha Networks proposes a 10-millisecond limit, as an alternative to its proposed limit on the probability of collision discussed above. For the same reason that we found that the Aloha Networks probability of collision limit is too restrictive, we find that it would be too restrictive to limit the duration of collisions to 10 milliseconds. Accordingly, we conclude that any contention protocol rule we adopt should limit the maximum duration of any collision to no more than 100 milliseconds. Based on these all the considerations above, we seek comment on a new contention protocol proposal below.

4. Revised Proposal

119. Based on the analysis above, we propose adopting a contention protocol rule that would apply an aggregate limit on off-axis EIRP density for VSAT networks using a contention protocol. Based on SIA's and Spacenet's pleadings, we also find that it would be reasonable to allow the power levels caused by collisions to increase as the probability of collision decreases, and to permit the power increases to be averaged over some period of time, such as one second. We further conclude that VSAT network operators using contention protocols should be required to limit the maximum duration of any collision to no more than 100 milliseconds. Based on these considerations, we propose that VSAT network operators using a contention protocol must meet the following requirements:

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[270] Aloha Networks Further Reply at 6.

[271] Based on Spacenet's assumptions on throughput and channel loading, the Bureau found that there was a 4.9 percent probability of a collision of two transmissions. *Spacenet Order*, 15 FCC Rcd at 23719 (App. A).

(i) For VSAT networks using a contention protocol, the aggregate off-axis EIRP shall not exceed the envelope set forth in Table 1 by more than the amounts set forth in Table 2;
(ii) The maximum duration of any single collision is less than 100 milliseconds.

Table 1 is the off-axis EIRP envelope proposed in Appendix C for digital transmissions from a single earth station in the Ku-band in the plane of the geostationary satellite orbit as it appears at the particular earth station location:

Table 1

$15 - 25\log_{10}\theta$	dBW/4 kHz	For	$1.5° \leq \theta \leq 7°$
-6	dBW/4 kHz	For	$7° < \theta \leq 9.2°$
$18 - 25\log_{10}\theta$	dBW/4 kHz	For	$9.2° < \theta \leq 48°$
- 24	dBW/4 kHz	For	$48° < \theta \leq 85°$
- 14	dBW/4 kHz	For	$85° < \theta \leq 180°$

where θ is the angle in degrees from the axis of the main lobe. Table 2 allows VSAT network operators to exceed the aggregate off-axis EIRP envelope by an increasing amount for a decreasing percentage of the time. The amounts in Table 2 are based on the SIA/Spacenet proposal in that the table would allow a 2 dB increase in EIRP for each decrease in order of magnitude in percentage of time.[272] Table 2 varies from the SIA/Spacenet proposal, however, in that it would not allow VSAT network operators to exceed the off-axis EIRP envelope for as much as 10 percent of the time. Instead, VSAT network operators may exceed the envelope for no more than 1 percent of the time under the proposal in Table 2.

[272] The "2K" and "10^{-K}" terms in the SIA/Spacenet proposal by themselves result in allowing a 2 dB increase in power for each order of magnitude decrease in probability of collision.

Table 2

Percentage of Time	Increase in Aggregate EIRP Allowed *
10% (10^{-1})	0 dB
1% (10^{-2})	2 dB
0.1% (10^{-3})	4 dB
0.01% (10^{-4})	6 dB
0.001% (10^{-5})	8 dB
0.0001% (10^{-6})	10 dB
0.00001% (10^{-7})	12 dB
0.000001% (10^{-8})	14 dB
0.0000001% (10^{-9})	16 dB

* The baseline for this power increase is – 14 dBW/4 kHz.

120. This approach seems to strike a reasonable balance between protecting adjacent satellites from harmful interference and allowing VSAT network operators to make efficient use of their facilities. Specifically, by requiring VSAT operators to meet an off-axis EIRP envelope in the aggregate, we should not allow any increase in the potential for harmful interference to adjacent satellites. On the other hand, VSAT network operators are given substantial flexibility as a result requiring operators to meet the envelope in the aggregate rather than on an individual earth station basis, and by allowing the operators to exceed the off-axis EIRP envelope by increasing amounts, provided that the amount of time that the envelope is exceeded is sufficiently low.

121. Parties opposing this proposal must provide an alternative proposal, and must explain in sufficient detail why they believe that their proposal strikes a better balance than the proposal in this *Third Further Notice* between (1) protection from harmful interference to adjacent satellites, and (2) allowing efficient VSAT network use.

122. Furthermore, while we are willing to consider the possibility that no power limit is required for collisions limited to 100 milliseconds, we expect parties supporting such an approach to provide more extensive justification for their recommendations. Arguing merely that their proposal strikes a reasonable balance between protection from harmful interference and efficient VSAT network use will not be sufficient by itself. In particular, we observe that the Commission originally was concerned that an earth station's transmission data would be significantly degraded, possibly beyond recovery, in cases where the earth station experiencing interference is operating in a narrower bandwidth or approximately the same as the interfering earth station.[273] Parties advocating no power limit should provide an adequate basis in the record for concluding that the Commission's concerns regarding narrow-bandwidth transmissions do not warrant some limit on power levels during collisions. We also repeat the recommendation in the *Further Notice* that commenters arguing that collisions are sufficiently limited by economic incentives should provide data showing that the amount of traffic in a VSAT network that would result in uneconomic levels of internal interference is less than the traffic levels that would cause harmful interference to adjacent satellites.[274]

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[273] *See Notice*, 15 FCC Rcd at 25146-47 (para. 54). *See also Spacenet Order*, 15 FCC Rcd at 23716 (para. 10), *cited in Notice*, 15 FCC Rcd at 25146-47 (para. 54).

[274] *See Further Notice*, 17 FCC Rcd at 18619 (para. 87).

123. In addition, we will consider proposals to limit power increases during collisions. Such a power increase limit could be set at a specific dB level, or it could increase as the probability of collision decreases, of the kind proposed by SIA and Spacenet.[275] Commenters recommending such an approach, however, must demonstrate that their proposals would not result in harmful interference to adjacent satellite operators. Such demonstrations must be adequately supported. We would consider interference analyses or link budgets, or any other data that the commenter believes to be persuasive.

124. We are also willing to consider proposals similar to those in the *Notice* and *Further Notice*, to require VSAT network operators using contention protocols to reduce their power levels to compensate for the power increases that will result from collisions.[276] As we emphasized above, however, parties advocating such a proposal must show that their proposal strikes a better balance between protection from harmful interference and efficient VSAT network use. In particular, any party proposing a limit must show that its proposal is not so restrictive that it would significantly limit the advantages of using contention protocols.

5. Other Contention Protocol Issues

a. Combination of Reservation and Contention Protocols

125. *Background.* In the *Notice*, the Commission noted that a VSAT network could use a combination of CDMA and Aloha multiple access techniques. Under this approach, transmissions are given codes to distinguish them from most other transmissions, and the VSAT network could rely on Aloha-type statistical calculations to keep simultaneous transmissions of signals with the same code within acceptable limits.[277]

126. Above, we explained that, in the *Notice*, the Commission's proposed power spectral density limit for VSAT networks using CDMA was -14.0 - 10log(N) dB(W/4 kHz), where N is "the maximum number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam."[278] For CDMA/Aloha systems, the Commission proposed setting N equal to 2 times the maximum number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam. This proposal was based on the value of N the Commission proposed for VSAT networks using Aloha, 2, and the value of N proposed it for VSAT networks using CDMA, the maximum number of co-frequency simultaneously transmitting earth stations.[279] We adopted the Commission's CDMA proposal above. The Commission decided in the *Further Notice*, however, to invite comment on alternatives to its proposal for CDMA/Aloha.[280]

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275 Spacenet Further Reply at 4-5; SIA Further Comments at 18-19; SIA Further Reply at 6; SIA October 3, 2003 *Ex Parte* Statement at 6-7.

276 *See Notice*, 15 FCC Rcd at 25147 (para. 55) and 25206-10 (App. E); *Further Notice*, 17 FCC Rcd at 18619-21 (paras. 90-94).

277 *Notice*, 15 FCC Rcd at 25209 (App. E).

278 *See* Section III.B.2. above, *citing Notice*, 15 FCC Rcd at 25208 (App. E). In the *Further Notice*, the Commission proposed defining "N" in terms of the "maximum" number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam, rather than the "likely maximum number." *Further Notice*, 17 FCC Rcd at 18622 (para. 100).

279 *See Notice*, 15 FCC Rcd at 25207-10 (App. E).

280 *Further Notice*, 17 FCC Rcd at 18618 (paras. 85-86).

127. *Discussion.* As part of its contention protocol proposal, SIA recommends a requirement for VSAT networks using CDMA/Aloha that is somewhat similar to the Commission's proposal in the *Notice*. Specifically, for VSAT networks using a combination of CDMA and Aloha, SIA would multiply the N from its proposed contention protocol rule discussed above by "the maximum number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam."[281]

128. We have decided not to adopt this proposal, for several reasons. First, as we pointed out above, this contention protocol proposal would allow licensees to exceed the otherwise applicable power spectral density limit by 2 dB up to 10 percent of the time, whenever the probability of two or more simultaneous transmissions is greater than 10 percent. We find that this would be excessive for VSAT networks using CDMA/Aloha for the same reasons that we found it was excessive for VSAT networks using other contention protocols. Second, part of the reason that the Commission decided not to adopt its original proposal for contention protocols was that it was limited to specific multiple access techniques.[282] This proposal seems to be designed specifically for VSAT networks using CDMA/Aloha, and so does not appear to be generally applicable. Finally, our proposed contention protocol requirements in this *Third Further Notice* are applicable to VSAT networks using either a contention protocol by itself, or in combination with a reservation protocol.

129. Accordingly, we invite comment on whether the contention protocol requirements proposed in this *Third Further Notice* above strike a reasonable balance between protecting adjacent satellites from harmful interference and not unreasonably restricting VSAT network operators who use contention protocols and reservation protocols in combination. Parties arguing that we need a distinct set of rules for contention protocols used in combination with reservation protocols should propose such rules, and explain in detail why those separate rules are necessary.

b. Extension of Contention Protocol Rules to Other Frequency Bands

130. *Background.* The Commission did not propose rules for C-band and Ka-band VSAT systems using contention protocols in the *Further Notice*.[283] The Commission reasoned that Ku-band contention protocol rules are needed because of the increase in anticipated future traffic volumes. Because C-band and Ka-band VSAT systems have just recently been introduced, the traffic volumes in those systems are not as great as they are in Ku-band VSAT systems. Therefore, the Commission proposed excluding C-band and Ka-band VSAT systems from contention protocol rules at this time.[284]

131. *Discussion.* SIA supports this proposal.[285] We will not propose any contention protocol rules for C-band or Ka-band VSATs at this time, for the reasons discussed in the *Further Notice*. Specifically, the traffic volumes in C-band or Ka-band VSAT networks at this time are not so great as to pose a significant risk of harmful interference to adjacent satellites. Instead, we will complete this

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281 SIA Further Comments at 21.

282 *Further Notice*, 17 FCC Rcd at 18620 (para. 92).

283 *Further Notice*, 17 FCC Rcd at 18624 (para. 103).

284 *Further Notice*, 17 FCC Rcd at 18624 (para. 103).

285 SIA Further Comments at 20.

proceeding to adopt contention protocol rules in the Ku-band, and develop experience with those rules before considering whether to extend those rules to other frequency bands.

c. Information Requirements

132. *Background.* In the *Further Notice*, the Commission invited comment on requiring VSAT system applicants to provide data on their planned levels of throughput, and to calculate the probability of transmissions on the same frequency within their respective VSAT networks. The Commission also sought comment on requiring these calculations as an attachment to the Form 312 earth station application.[286]

133. *Discussion.* SIA and Spacenet recommend that any regulations require a certification of compliance rather than a detailed probability showing.[287] We propose adopting SIA's and Spacenet's recommendation. In a prior Order, when the Commission adopted out-of-band emission requirements for mobile earth terminals (METs) in the 1.6 GHz band, it rejected a proposal to require advance approval of any plan to rely on network software to meet those emission requirements. Specifically, given that there was no convincing showing that there was a need for a prior approval process, the Commission stated that it would require only that MET licensees certify that they will comply with the applicable requirements.[288] Similarly, we find here that, in the absence of a convincing showing that a more detailed technical requirement is warranted, we should require VSAT licensees only to certify that they will meet any applicable requirements for contention protocols that we may adopt in this proceeding. We invite comment on this analysis. We also invite comment on requiring any party questioning a license applicant's contention protocol certification to provide a technical analysis showing that the applicant's planned contention protocol usage is likely to cause harmful interference to adjacent satellites or terrestrial wireless operations.

d. Grandfathering

134. For contention protocols, the Commission invited comment on a three-part transition.[289] First, VSAT systems using Aloha or other contention protocol random access techniques licensed before the release date of the *Report and Order* in this proceeding would be allowed to continue operations under the current requirements. After the effective date of any rules we adopt, however, the first time that those VSAT system operators request a modification or renewal of their licenses, they would be required to include a modification of their operations to comply with those rules.[290] Second, with respect to VSAT systems licensed between the release date of this Order and the effective date of any rules we adopt, the Commission proposed requiring those system operators to file modifications to their systems to come into compliance with these rules within 90 days after those rules take effect.[291] Third, the Commission

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286 *Further Notice*, 17 FCC Rcd at 18620 (para. 93).

287 SIA Further Comments at 19-20; SIA Further Reply at 9; Spacenet Further Reply at 5.

288 Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements, *Report and Order and Further Notice of Proposed Rulemaking*, IB Docket No. 99-67, 17 FCC Rcd 8903, 8920 (para. 40) (2002).

289 *Further Notice*, 17 FCC Rcd at 18625 (para. 108).

290 *Further Notice*, 17 FCC Rcd at 18625 (para. 108).

291 *Further Notice*, 17 FCC Rcd at 18625 (para. 108).